

FERROALLOYS

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Ferroalloys are alloys of iron in which one or more chemical elements are added into molten metal, usually in steelmaking. The top six ferroalloy-producing countries in 2003, in decreasing order of production, were China, South Africa, Ukraine, Kazakhstan, Russia, and Norway, the same as in 2002. Ferroalloys impart distinctive qualities to steel and cast iron or serve important functions during the production cycle.

The ferroalloy industry is closely associated with the iron and steel industry, the largest consumer of its products. World production in 2003 of the bulk ferroalloys—chromium, manganese, and silicon—was estimated to be 19.9 million metric tons (Mt), an 11% increase compared with the revised figure for 2002. U.S. bulk ferroalloy reported consumption in 2003 was 1.1 Mt. Compared with that of 2002, ferrochromium consumption increased 5%, while other bulk ferroalloys—manganese (including silicomanganese) and ferrosilicon—consumption decreased 9% and 5%, respectively. U.S. total ferroalloy production, as reported in table 6, decreased by 5%, while U.S. total ferroalloy imports (table 5) rose by 31% and exports (table 5) dropped by 49%. These percentages reflect a recovery in the U.S. steel industry in the latter part of 2003.

The principal ferroalloys are those of chromium, manganese, and silicon. Manganese is essential to the production of virtually all steels and is important to the production of cast iron. Manganese is used to neutralize the harmful effect of sulfur and as an alloying element. Silicon is used primarily for deoxidation in steel and as an alloying element in cast iron. Boron, chromium, cobalt, columbium (niobium), copper, molybdenum, nickel, phosphorus, titanium, tungsten, vanadium, zirconium, and the rare-earth elements are among the other elements contributing to the character of the various alloy steels and cast irons (Brown and Murphy, 1985, p. 265).

Compared with that of major ferroalloy-producing countries, U.S. ferroalloy production was moderate in silicon and manganese and relatively low in other ferroalloy metals. Consequently, U.S. ferroalloy production meets only a small percentage of domestic demand. One important exception is silicon ferroalloys. U.S. production of ferrosilicon, which included miscellaneous silicon alloys, was approximately 40% of apparent consumption of ferrosilicon in 2003. U.S. production of silicon metal, excluding semiconductor-grade material, was about 60% of apparent consumption of silicon metal in 2003.

In countries with competitive mineral resources, the trend is toward increased production of value-added products, particularly in the case of chromium. U.S. production is unlikely to expand because U.S. mineral resources for most of the ferroalloy metals are less competitive. The overall domestic ferroalloy production trend, therefore, is one of decline. By 1999, U.S. production of ferronickel and common grades of ferrochromium had ceased. In both cases, production stopped because resources were low grade, producers were relying on imported ore for feedstock, and operating costs were high. In contrast, ferrosilicon and manganese ferroalloy production have fluctuated, with ferrosilicon production decreasing and manganese ferroalloy production generally increasing during the past 7 years, with the exception of 2003.

Chromium, manganese, silicon, and other ferroalloys are discussed in more detail, including domestic data coverage and outlook and U.S. Government stockpile, in the respective mineral commodity chapters in the U.S. Geological Survey Minerals Yearbook. The tables in this chapter contain information on all ferroalloys for which data are available.

Ferrochromium

The major world chromite ore-producing countries in 2003 were India (more than 2 Mt), Kazakhstan (also more than 2 Mt), and South Africa (more than 7 Mt). In excess of 90% of chromite ore was smelted in electric-arc furnaces to produce ferrochromium for use by the metallurgical industry. The major world ferrochromium-producing countries were Kazakhstan (1 Mt), and South Africa (more than 2 Mt). Stainless steel manufacture consumed most of the 5.7 Mt of ferrochromium produced. Europe (primarily Western Europe and Scandinavia including Belgium, Finland, France, Germany, Italy, Spain, Sweden, and the United Kingdom), Asia (Japan, Korea, and Taiwan) and the United States—the major stainless steel producing areas of the world—account for about 80% of world stainless steel production.

The ferrochromium industry developed in close proximity to the stainless steel industry. However, the closing of ferrochromium facilities in these historically producing areas has resulted in the migration of ferrochromium production to chromite-producing areas. The world chromium industry in 2003 operated with production capacity in excess of demand. In anticipation of demand growth, new ferrochromium-producing plants were brought into production, under construction, or planned in South Africa. Four industry trends were evolving—ferrochromium production using environmentally friendly, energy- and recovery-efficient, prereduction, closed-furnace processes; chromium recovery from ferrochromium slag; consolidation of ownership in both the ferrochromium and stainless steel production industries; and strategic alliances between the latter two industries.

Ferromanganese

Manganese ferroalloys, consisting of various grades of ferromanganese and silicomanganese, are used to provide a key ingredient for steelmaking (Matricardi and Downing, 1995, p. 970). Most U.S. supply was imported. The leading foreign source of ferromanganese and silicomanganese was South Africa, whose exports of manganese ferroalloys to the United States were greater than those of the next five largest importing countries combined (Australia, Brazil, France, Mexico, and Norway). Manganese ferroalloys were produced domestically mainly at a plant near Marietta, OH, which was owned by France's Eramet Group, with some production at Highlanders Alloys LLC plant located at New Haven, WV, which ceased production in January 2003. Eramet Group and BHP Billiton plc of the United Kingdom accounted for a significant portion of the world's production of manganese ferroalloys. In addition to its U.S. plant, the Eramet Group controlled plants in China, France, Italy, and Norway, and BHP Billiton controlled plants in Australia and South Africa. On a country basis, China continued to be by far the largest producer of manganese ferroalloys, with an output greater than that of South Africa and Ukraine combined, the countries with the next largest production (table 6).

Ferromolybdenum

The major molybdenite ore-producing countries in 2003 were Chile, China, and the United States, accounting for about 75% of world production. Other significant ore-producing countries, including Armenia, Canada, Mexico, and Peru, supplied an additional 19% of world production. Molybdenite ore is roasted to form molybdic oxide which can be converted into ferromolybdenum, molybdenum chemicals, or metal. About one-third of the molybdenum consumed in the United States was in the form of molybdic oxides, and about one-fourth was as ferromolybdenum. Although the United States was the leading molybdenum-producing country in the world, it imported more than 98% of its ferromolybdenum requirements in 2003. Overall, the steel industry accounted for about 75% of all molybdenum consumed in the United States in 2003, principally in the production of stainless steel and full alloy steel.

Ferrosilicon

Demand for silicon ferroalloys is driven principally by the production of steel and cast iron (Dosaj, 1997, p. 1115). On the basis of silicon content, U.S. production of silicon ferroalloys (ferrosilicon and miscellaneous silicon alloys) and silicon metal decreased by 5% to 248,000 metric ton (t) from 261,000 t in 2002. Ferrosilicon imports in 2003 increased significantly. U.S. net production of silicon ferroalloys and metal in 2003 decreased by 6% from that of 2002 (table 6). China was estimated to be the world's largest producer of ferrosilicon, with production almost twice that of the next two largest producing countries combined, Norway and Russia. While some silicon metal was used as an alloying agent with iron in 2003, the bulk of it was used as an alloying agent with aluminum and in the production of chemicals, especially silicones.

Ferrotitanium

Titanium is used in steelmaking for deoxidation, grain-size control, and carbon and nitrogen control and stabilization. During steelmaking, titanium is introduced usually in the form of ferrotitanium because of its lower melting point and higher density when compared with those of titanium scrap. World ferrotitanium production capacity is led by, in descending capacity order, the United Kingdom, Russia, Japan, and the United States. Domestic producers of ferrotitanium were Global Titanium, Inc. (Detroit, MI) and Galt Alloys Inc. (North Canton, OH). Consumption by the steel industry was largely associated with the production of stainless steels. In 2003, a shortage of titanium scrap caused ferrotitanium prices to rise. The yearend price for ferrotitanium with 70% contained titanium was about \$3.10 per pound, a 43% increase compared with that of 2002. Imports of ferrotitanium and ferro-silicon-titanium were 3,160 t, a 15% decrease compared with those of 2002.

Ferrovanadium

The major vanadium-producing countries in 2003 were China and South Africa, accounting for about 84% of world production, with Russia, the other significant vanadium-producing country, accounting for an additional 14%. Vanadium is primarily recovered from titaniferous magnetite ore processed to produce liquid pig iron in these three countries. The process also produces a vanadium-bearing slag, which can be further processed to 40% to 50% vanadium-content ferrovanadium. Vanadium oxides, recovered from petroleum residues, ashes, and poisoned refinery catalysts, represented the only vanadium recovered in the United States in 2003 as there was no primary production. Vanadium oxides were used to produce catalysts, chemicals, and 75% to 80% vanadium-content ferrovanadium. The world vanadium industry in 2003 operated with production capacity in excess of demand with petroleum-based vanadium recovery (residues, ashes, catalysts) continuing to grow. The steel industry accounted for about 92% of all vanadium consumed in the United States in 2003, principally in carbon, full alloy and high-strength, low-alloy steels. About 72% of the vanadium consumed was as ferrovanadium, and the United States imported about 80% of its ferrovanadium requirements in 2003.

Outlook

Alternative materials, principally alloy scrap and oxide, have gained moderately on ferroalloy use per ton of steel produced during the past 20 years. A decline in unit consumption is significant over the long term for the ferroalloy industry because such a decline moderates any increase in ferroalloy consumption resulting from increased steel production. A combination of factors, including technology, availability, and price, is responsible for this general decline in unit consumption of the major ferroalloys in steelmaking.

U.S. customer needs for ferroalloys in alloy and stainless steel for many applications have been and will continue to be strong. The steel industry will continue to improve processing technology to reduce raw material needs and develop steel grades with lower alloying metal content that equals or better performance, while lowering materials costs. For many stainless steel applications, there are no acceptable substitutes, and their key constituents, chromium and nickel, are essential. As technology and industry practices result in more efficient use of ferroalloys, strong demand for metals in construction, the chemical industry, transportation, and household appliances is expected to more than offset any basic reduction in unit consumption. Competition from other materials, such as plastics and nonferrous metals in the transportation sector, will be strong, but the use of lightweight, high-strength steel is expected to keep the ferroalloys industry competitive for many years (Sibley and others, 2001, p. 40).

References Cited

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TABLE 1
GOVERNMENT INVENTORY OF FERROALLOYS, DECEMBER 31, 2003^{1, 2}

(Metric tons of alloy unless otherwise specified)

| Alloy | Inventory |
|-----------------------------------|-------------------|
| Ferrochromium: | |
| High-carbon | 466,000 |
| Low-carbon | 217,000 |
| Ferromanganese, high carbon | 700,000 |
| Ferrotungsten, contained tungsten | kilograms 263,000 |

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Data are uncommitted inventory.

Source: Defense National Stockpile Center.

TABLE 2
REPORTED U.S. CONSUMPTION OF FERROALLOYS AS ALLOYING ELEMENTS BY END USE IN 2003^{1, 2}

(Metric tons of alloys unless otherwise specified)

| End use | FeB | Manganese | | FeP | FeSi | FeTi |
|---|--------------------|----------------------|---------------------|--------------------|-------------------------|--------------------|
| | | FeMn | SiMn | | | |
| Steel: | | | | | | |
| Carbon and high-strength low-alloy | 576 | 208,000 | 58,900 | 3,870 | 16,300 ^{3, 4} | 3,690 |
| Stainless and heat-resisting | 244 | 8,550 | 11,700 | -- | 46,800 ³ | 3,050 |
| Other alloy | (5) | 21,200 | 19,500 | 830 | 5,850 ³ | 153 |
| Tool | -- | (3) | (3) | -- | 26,800 ³ | (6) |
| Unspecified | -- | 1,600 | 738 | (6) | 35,100 ⁷ | -- |
| Total steel | 820 | 239,000 | 90,800 | 4,700 | 131,000 | 6,890 |
| Cast irons | -- | 7,930 | 700 | 1,150 | 114,000 | 38 |
| Superalloys | 66 | (4) | -- | (7) | 82 ^{7, 8} | 1,160 |
| Alloys (excluding alloy steels and superalloys) | 415 | 1,240 | (4) | (7) | 177,000 ^{4, 8} | 734 |
| Miscellaneous and unspecified | -- | (4) | (4) | -- | 55,100 ⁷ | (7) |
| Grand total | 1,300 | 248,000 | 91,500 | 5,850 | 477,000 | 8,820 |
| Total 2002 | 1,260 ^r | 272,000 ^r | 84,200 ^r | 6,080 ^r | 500,000 | 8,170 ^r |
| Percentage of 2002 | 103 | 91 | 109 | 96 | 95 | 108 |
| Consumer stocks, December 31 | 263 | 24,500 | 6,050 | 877 | 14,100 | 756 |

^rRevised. NA Not available. -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²FeB, ferroboron, including other boron materials; FeMn, ferromanganese, including manganese metal and other manganese alloys; SiMn, silicomanganese; FeP, ferrophosphorus, including other phosphorus materials; FeSi, ferrosilicon, including silicon metal, silvery pig iron, silicon carbide, and inoculant alloys; FeTi, ferrotitanium, including titanium scrap and other titanium materials.

³All or part included with "Steel, unspecified."

⁴All or part withheld to avoid disclosing company proprietary data.

⁵Included with "Steel, stainless and heat-resisting."

⁶Included with "Steel, other alloy."

⁷All or part included with "Cast irons."

⁸Part included with "Miscellaneous and unspecified."

TABLE 3

REPORTED U.S. CONSUMPTION OF FERROALLOYS AS ALLOYING ELEMENTS BY END USE IN 2003^{1,2}

(Metric tons of contained elements unless otherwise specified)

| End use | FeCr | FeMo | FeNb | FeNi | FeV | FeW |
|---|----------------------|--------------------|-------|--------|-------|-----|
| Steel: | | | | | | |
| Carbon and high-strength low-alloy | 3,550 ³ | 474 | 2,100 | -- | 1,710 | (4) |
| Stainless and heat-resisting | 205,000 | 830 | 612 | 13,600 | 64 | (4) |
| Other alloy | 14,400 ⁵ | 1,920 | (6) | W | 799 | (4) |
| Tool | 3,480 | W | (6) | W | 143 | (4) |
| Unspecified | W | -- | -- | -- | -- | (4) |
| Total | 226,000 | 3,230 | 2,710 | 13,600 | 2,710 | 288 |
| Cast irons | W | 321 | W | (7) | W | -- |
| Superalloys | 6,550 | 20 | 933 | -- | 10 | (4) |
| Alloys (excluding alloy steels and superalloys) | 1,290 | 78 | W | 18 | W | (4) |
| Miscellaneous and unspecified | 13,200 ⁸ | 99 | 8 | -- | 235 | -- |
| Grand total | 247,000 | 3,750 | 3,650 | 13,700 | 2,960 | 288 |
| Total 2002 | 236,000 ^r | 3,560 ^r | 3,150 | 12,500 | 3,080 | 285 |
| Percentage of 2002 | 105 | 105 | 116 | 109 | 96 | 101 |
| Consumer stocks, December 31 | 9,970 | 206 | NA | 745 | 195 | 32 |

^rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; included with

"Miscellaneous and unspecified." -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.²FeCr, ferrochromium, including other chromium ferroalloys and chromium metal; FeMo, ferromolybdenum, including calcium molybdate; FeNb, ferrocolumbium, including nickel columbium; FeNi, ferronickel; FeV, ferrovanadium, including other vanadium-carbon-iron ferroalloys; and FeW, ferrotungsten.³All or part included with "Steel, other alloy."⁴Included with "Steel, total."⁵Includes full alloy and high-strength low-alloy steel.⁶Included with "Carbon and high-strength low-alloy."⁷Included with "Alloys (excluding alloy steels and superalloys)."⁸Includes cast irons, electric steel, and unspecified uses.

TABLE 4
FERROALLOY PRICES IN 2003

| | High | Low | Average ¹ |
|--|--------|--------|----------------------|
| Chromium: | | | |
| Ferrochromium: | | | |
| 0.05% carbon ² | 83.00 | 70.00 | 73.07 |
| 0.10% carbon ² | 75.00 | 60.00 | 62.39 |
| 0.15% carbon ² | 70.00 | 56.00 | 59.76 |
| Over 4% carbon: | | | |
| 50-55% chromium ² | 57.00 | 34.00 | 44.29 |
| 60-65% chromium ² | 57.00 | 33.50 | 43.67 |
| Columbium, ferrocolumbium ³ | 6.70 | 6.45 | 6.58 |
| Manganese: | | | |
| Medium-carbon ferromanganese ² | 53.00 | 40.00 | 43.29 |
| Standard-grade ferromanganese ⁴ | 605.00 | 455.00 | 493.78 |
| Silicomanganese ⁵ | 33.00 | 23.00 | 27.26 |
| Molybdenum: | | | |
| Ferromolybdenum ⁶ | 9.00 | 4.50 | 5.90 |
| Molybdenum oxide ⁶ | 7.80 | 3.15 | 5.29 |
| Silicon: | | | |
| 50% ferrosilicon ² | 56.00 | 42.00 | 47.74 |
| 75% ferrosilicon ² | 50.00 | 38.00 | 45.22 |
| Silicon metal ⁵ | 66.00 | 58.00 | 61.27 |
| Vanadium, ferrovanadium ⁶ | 6.00 | 4.00 | 5.26 |

¹Annual time-weighted average.

²Cents per pound of contained element.

³Yearend average value in dollars per pound of contained columbium (niobium), standard (steelmaking) grade.

⁴Dollars per long ton.

⁵Cents per pound.

⁶Dollars per pound of contained element.

Sources: American Metal Market, Platts Metals Week, and Ryan's Notes.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION AND EXPORTS OF FERROALLOYS AND FERROALLOY METALS IN 2003¹

(Metric tons unless otherwise specified)

| Alloy | Imports | | | Exports | | |
|--|--------------|----------------------|-------------------|--------------|------------------|-------------------|
| | Gross weight | Contained weight | Value (thousands) | Gross weight | Contained weight | Value (thousands) |
| Ferroalloys: | | | | | | |
| Chromium ferroalloys: | | | | | | |
| Ferrocromium containing: | | | | | | |
| More than 4% carbon | 366,000 | 210,000 | \$162,000 | 3,180 | 1,930 | \$2,720 |
| Not more than 4% carbon | XX | XX | XX | 1,230 | 733 | 2,000 |
| More than 3% but not more than 4% carbon | -- | -- | -- | XX | XX | XX |
| More than 0.5% but not more than 3% carbon | 5,340 | 3,420 | 3,200 | XX | XX | XX |
| Not more than 0.5% carbon | 19,500 | 13,400 | 24,100 | XX | XX | XX |
| Ferrocromium-silicon | 38,700 | 16,200 | 24,900 | 481 | 168 | 511 |
| Total | 429,000 | 243,000 | 214,000 | 4,890 | 2,830 | 5,240 |
| Manganese ferroalloys: | | | | | | |
| Ferromanganese containing: | | | | | | |
| More than 4% carbon | 167,000 | 130,000 | 65,200 | XX | XX | XX |
| More than 2% but not more than 4% carbon | 59 | 50 | 27 | XX | XX | XX |
| More than 1% but not more than 2% carbon | 48,600 | 39,100 | 32,600 | XX | XX | XX |
| Not more than 1% carbon | 22,400 | 19,000 | 19,500 | XX | XX | XX |
| Ferromanganese, all grades | 238,000 | 187,000 | 117,000 | 10,600 | XX | 8,840 |
| Silicomanganese | 267,000 | 182,000 | 133,000 | 606 | XX | 554 |
| Total | 743,000 | 557,000 | 367,000 | 11,200 | XX | 9,390 |
| Silicon ferroalloys: | | | | | | |
| Ferrosilicon containing: | | | | | | |
| More than 90% silicon | 66 | 53 | 30 | 5,820 | 3,500 | 5,070 |
| More than 55% but not more than 80% silicon and more than 3% calcium | 2,040 | 1,310 | 1,810 | XX | XX | XX |
| More than 55% but not more than 80% silicon and not more than 3% calcium | 225,000 | 169,000 | 151,000 | XX | XX | XX |
| Magnesium ferrosilicon | 30,300 | 13,900 | 22,700 | XX | XX | XX |
| Ferrosilicon, other ² | 12,200 | 4,910 | 7,570 | 5,780 | 2,860 | 5,370 |
| Total | 269,000 | 189,000 | 183,000 | 11,600 | 6,370 | 10,400 |
| Other ferroalloys: | | | | | | |
| Ferrocerium and other pyrophoric alloys and other | 115 | XX | 1,650 | XX | XX | XX |
| Ferrocolumbium | 6,280 | XX | 54,700 | 143 | XX | 1,430 |
| Ferromolybdenum | 5,740 | 3,690 | 37,500 | 1,030 | 617 | 8,660 |
| Ferronickel | 33,000 | 13,100 | 109,000 | 277 | 182 | 2,520 |
| Ferrophosphorus | 11,700 | XX | 2,250 | 787 | XX | 511 |
| Ferrotitanium and ferrosilicon-titanium | 3,160 | XX | 9,670 | 967 | XX | 2,930 |
| Ferrotungsten and ferrosilicon-tungsten | 488 | 377 | 2,380 | 105 | 59 | 214 |
| Ferrovandium | 1,690 | 1,360 | 14,300 | 538 | 397 | 5,420 |
| Ferrozirconium | 154 | XX | 245 | 1,930 | XX | 2,030 |
| Ferroalloys, other | 16,200 | XX | 19,000 | 1,350 | XX | 2,470 |
| Total | 78,500 | 18,500 | 251,000 | 7,130 | 1,250 | 26,200 |
| Total ferroalloys | 1,520,000 | 1,010,000 | 1,020,000 | 34,800 | 10,500 | 51,200 |
| Metals: | | | | | | |
| Chromium (total, all grades) | 8,570 | XX | 45,200 | 941 | XX | 11,900 |
| Manganese, other: | | | | | | |
| Unwrought | 17,000 | XX | 18,200 | XX | XX | XX |
| Other | 2,790 | XX | 2,610 | XX | XX | XX |
| Silicon: | | | | | | |
| Less than 99% silicon | 41,000 | 39,900 | 35,500 | 9,600 | 9,320 | 16,800 |
| Less than 99.99% but not less 99% silicon | 104,000 | 104,000 ³ | 125,000 | 2,250 | 2,230 | 4,330 |
| Not less than 99.99% silicon | 1,410 | XX | 75,900 | 8,290 | XX | 347,000 |
| Total | 175,000 | 144,000 | 303,000 | 21,100 | 11,500 | 380,000 |
| Grand total | 1,690,000 | 1,150,000 | 1,320,000 | 55,900 | 22,100 | 431,000 |

XX Not applicable. -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes less than 55% silicon and greater than 80% silicon.

³Data adjusted by the U.S. Geological Survey.

Source: U.S. Census Bureau.

TABLE 6
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE^{1,2}

(Metric tons, gross weight)

| Country, furnace type, and alloy type ^{3,4,5} | 1999 | 2000 | 2001 | 2002 | 2003 ^c |
|--|----------------------|----------------------|----------------------|------------------------|----------------------|
| Albania, electric furnace ferrochromium | 28,120 | 12,500 | 11,900 | 22,100 ^r | 37,800 ⁶ |
| Argentina, electric furnace: | | | | | |
| Ferrosilicon | 2,568 | 2,500 ^e | 2,740 | 1,072 ^r | 1,100 |
| Silicomanganese | -- | 4,900 | 5,150 | 5,000 ^e | 5,000 |
| Silicon metal ^e | 8,000 ⁶ | 8,000 | 8,000 | 8,000 | 8,000 |
| Other ⁷ | 13,850 | 16,900 | 9,925 | 17,289 ^r | 15,000 |
| Total | 24,418 | 32,300 | 25,815 | 31,361 ^r | 29,100 |
| Australia, electric furnace: ^e | | | | | |
| Ferromanganese | 98,000 | 115,000 | 115,000 | 115,000 | 115,000 |
| Silicomanganese | 116,000 | 135,000 | 135,000 | 135,000 | 135,000 |
| Silicon metal | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| Total | 244,000 | 280,000 | 280,000 | 280,000 | 280,000 |
| Austria, electric furnace: ^e | | | | | |
| Ferronickel | 4,250 | 4,200 | 4,000 | 4,000 | 4,000 |
| Other | 5,000 | 5,000 | 4,000 | 4,000 | 4,000 |
| Total | 9,250 | 9,200 | 8,000 | 8,000 | 8,000 |
| Bhutan, electric furnace, ferrosilicon ^e | 18,000 | 15,000 | 16,000 | 21,000 ^r | 21,000 |
| Bosnia and Herzegovina, electric furnace: ^e | | | | | |
| Ferrosilicon | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Silicon metal | 200 | 200 | 200 | 200 | -- |
| Total | 1,200 | 1,200 | 1,200 | 1,200 | 1,000 |
| Brazil, electric furnace: | | | | | |
| Ferrochromium ⁸ | 90,784 | 172,443 ^r | 110,468 ^r | 164,140 ^r | 196,032 ⁶ |
| Ferrochromiumsilicon ^e | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| Ferromanganese | 110,000 ^r | 121,277 | 96,016 | 149,000 ^r | 145,000 |
| Ferronickel | 19,807 | 19,315 | 17,966 | 19,874 ^r | 19,378 ⁶ |
| Ferrosilicon | 200,833 | 188,735 | 159,345 | 159,400 ^r | 160,000 |
| Silicomanganese | 116,822 | 171,304 | 180,235 | 180,200 ^r | 180,000 |
| Silicon metal | 120,000 | 166,344 | 112,123 | 112,100 ^r | 112,000 |
| Other ^c | 76,000 | 76,000 | 76,000 | 76,000 | 76,000 |
| Total | 739,246 ^r | 920,418 ^r | 757,153 ^r | 865,714 ^r | 893,000 |
| Bulgaria, electric furnace: ^e | | | | | |
| Ferrosilicon | 8,000 | 8,000 | 8,000 | 8,000 | 8,000 |
| Other | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Total | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Canada, electric furnace: ^e | | | | | |
| Ferrosilicon | 56,000 | 56,000 | 56,000 | 56,000 | 56,000 |
| Ferrovanadium | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Silicon metal | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| Total | 87,000 | 87,000 | 87,000 | 87,000 | 87,000 |
| Chile, electric furnace: | | | | | |
| Ferromanganese | 2,833 | 4,011 | 2,213 ^r | 2,500 ^{r,c} | 2,600 |
| Ferromolybdenum | 2,079 | 1,454 | 1,784 ^r | 1,784 ^r | 3,170 ⁶ |
| Ferrosilicon | 1,000 | 1,100 | 1,100 ^e | 1,100 ^e | 1,100 |
| Silicomanganese | 2,048 | 1,800 | 1,800 ^e | 1,800 ^e | 1,800 |
| Total | 7,960 | 8,365 | 6,897 ^r | 7,184 ^r | 8,670 |
| China: ^c | | | | | |
| Blast furnace: | | | | | |
| Ferromanganese | 550,000 | 500,000 | 500,000 | 500,000 | 550,000 |
| Other | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 |
| Electric furnace: | | | | | |
| Ferrochromium | 400,000 | 450,000 | 310,000 | 330,000 ^r | 500,000 |
| Ferromanganese | 550,000 | 520,000 | 670,000 | 490,000 ^r | 700,000 |
| Ferromolybdenum | 38,500 | 44,400 | 37,700 | 29,600 | 29,400 |
| Ferrosilicon | 1,120,000 | 1,400,000 | 1,320,000 | 1,500,000 | 2,200,000 |
| Silicomanganese | 822,000 | 900,000 | 1,170,000 | 1,580,000 ^r | 1,800,000 |
| Other | 220,000 ^r | 116,000 ^r | 392,000 ^r | 310,000 ^r | 461,000 |
| Total | 3,800,000 | 4,030,000 | 4,500,000 | 4,840,000 | 6,340,000 |

See footnotes at end of table.

TABLE 6--Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE^{1,2}

(Metric tons, gross weight)

| Country, furnace type, and alloy type ^{3,4,5} | 1999 | 2000 | 2001 | 2002 | 2003 ^c |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|
| Colombia, electric furnace, ferronickel | 61,137 ^r | 59,129 ^r | 91,475 ^r | 111,952 ^r | 111,324 ⁶ |
| Croatia, electric furnace, ferrochromium | -- | 15,753 | 361 | -- ^e | -- |
| Czech Republic, electric furnace, other ^c | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Dominican Republic, electric furnace, ferronickel | 85,000 | 84,900 | 60,654 | 59,654 | 69,800 |
| Egypt, electric furnace: ^c | | | | | |
| Ferromanganese | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| Ferrosilicon | 44,000 | 45,000 | 40,000 ^r | 40,000 ^r | 40,000 |
| Total | 74,000 | 75,000 | 70,000 ^r | 70,000 ^r | 70,000 |
| Finland, electric furnace, ferrochromium | 256,290 | 260,605 | 236,710 | 248,181 | 250,040 ⁶ |
| France: ^c | | | | | |
| Blast furnace, ferromanganese | 302,000 ⁶ | 300,000 | 300,000 | 300,000 | 180,000 |
| Electric furnace: | | | | | |
| Ferromanganese | 138,000 | 140,000 | 130,000 | 130,000 | 120,000 |
| Ferrosilicon | 110,000 | 110,000 | 100,000 | 100,000 | 100,000 |
| Silicomanganese ⁹ | 55,000 | 60,000 | 50,000 | 50,000 | 107,000 |
| Silicon metal | 75,000 | 75,000 | 75,000 | 75,000 | 75,000 |
| Other | 20,000 | 20,000 | 65,000 | 65,000 | 65,000 |
| Total | 700,000 | 705,000 | 720,000 | 720,000 | 647,000 |
| Georgia, electric furnace: ^c | | | | | |
| Ferromanganese | 6,500 | 7,000 | 7,000 | 7,000 | 7,000 |
| Silicomanganese | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 |
| Total | 31,500 | 32,000 | 32,000 | 32,000 | 32,000 |
| Germany, electric furnace: ^c | | | | | |
| Ferrochromium | 16,960 ⁶ | 21,600 ⁶ | 19,308 ⁶ | 20,018 ⁶ | 18,318 ⁶ |
| Silicon metal | 20,000 | 26,000 | 25,000 | 25,000 | 25,000 |
| Other ¹⁰ | 30,000 | 30,000 | 32,000 | 30,000 | 30,000 |
| Total | 67,000 | 77,600 | 76,300 | 75,000 | 73,300 |
| Greece, electric furnace, ferronickel | 59,545 | 81,662 | 84,200 ^e | 91,600 ^e | 90,000 |
| Hungary, electric furnace: ^{c,11} | | | | | |
| Ferrosilicon | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 |
| Silicon metal | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Total | 8,000 | 8,000 | 8,000 | 8,000 | 8,000 |
| Iceland, electric furnace, ferrosilicon | 70,900 | 70,000 ^e | 111,948 | 112,000 ^e | 115,000 |
| India, electric furnace: ^c | | | | | |
| Ferrochromium ¹² | 312,140 ⁶ | 376,693 ⁶ | 267,395 ⁶ | 311,927 ⁶ | 468,677 ⁶ |
| Ferrochromiumsilicon | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Ferromanganese | 160,000 | 160,000 | 165,000 | 165,000 | 165,000 |
| Ferrosilicon | 55,000 | 60,000 | 50,000 | 52,000 | 54,000 |
| Silicomanganese | 190,000 | 185,000 | 150,000 | 150,000 | 160,000 |
| Other | 9,000 | 9,000 | 9,000 | 9,000 | 9,000 |
| Total | 736,000 | 801,000 | 651,000 | 698,000 | 867,000 |
| Indonesia, electric furnace: | | | | | |
| Ferromanganese ^c | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 |
| Ferronickel | 44,068 | 47,749 | 47,769 | 42,306 | 44,660 ⁶ |
| Silicomanganese ^c | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 |
| Total | 63,068 | 66,749 | 66,769 | 61,306 ^r | 63,700 |
| Iran, electric furnace: | | | | | |
| Ferrochromium | 13,680 | 11,505 | 8,430 | 15,000 | 17,000 ⁶ |
| Ferrosilicon ^c | 46,000 | 40,000 | 40,000 | 41,700 ^r | 40,000 |
| Total ^c | 59,700 | 51,500 | 48,400 | 56,700 ^r | 57,000 |
| Italy, electric furnace: ^c | | | | | |
| Ferromanganese | 19,000 ⁶ | 40,000 | 40,000 | 40,000 | 40,000 |
| Silicomanganese | 67,000 | 90,000 | 90,000 | 90,000 | 90,000 |
| Silicon metal | 6,257 ⁶ | 5,000 | 6,000 | 6,000 | 6,000 |
| Other ¹³ | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Total | 102,000 | 145,000 | 146,000 | 146,000 | 146,000 |

See footnotes at end of table.

TABLE 6--Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE^{1,2}

(Metric tons, gross weight)

| Country, furnace type, and alloy type ^{3,4,5} | 1999 | 2000 | 2001 | 2002 | 2003 ^c |
|---|----------------------|----------------------|---------------------|-------------------------|------------------------|
| Japan, electric furnace: | | | | | |
| Ferrochromium ¹⁴ | 119,777 | 130,074 | 111,167 | 91,937 | 26,000 |
| Ferromanganese | 315,152 | 337,694 | 368,293 | 356,717 | 375,000 |
| Ferronickel | 332,293 | 367,181 | 367,739 | 370,973 | 369,099 ⁶ |
| Ferrosilicon | 1,452 | -- | -- | -- | -- |
| Silicomanganese | 65,744 | 67,926 | 62,238 | 70,965 | 60,000 |
| Other ¹⁵ | 12,860 | 15,020 | 12,940 | 12,352 | 12,000 |
| Total | 847,278 | 917,895 | 922,377 | 902,944 | 842,000 |
| Kazakhstan, electric furnace: | | | | | |
| Ferrochromium | 731,563 | 799,762 | 761,900 | 835,800 | 993,000 ⁶ |
| Ferrochromiumsilicon | 49,282 | 55,634 | 79,800 | 102,200 | 98,130 ⁶ |
| Ferromanganese | -- | 1,075 | 5,349 | 2,278 | 1,931 ⁶ |
| Ferrosilicon | 140,263 | 133,269 | 145,800 | 127,300 | 127,160 ⁶ |
| Silicomanganese | 78,495 | 102,719 | 141,200 | 164,000 | 178,920 ⁶ |
| Other ^c | 9,000 | 9,000 | 9,000 | 9,000 | 9,000 |
| Total | 1,008,603 | 1,101,459 | 1,143,049 | 1,240,578 | 1,408,141 ⁶ |
| Korea, North, electric furnace: ^c | | | | | |
| Ferromanganese ¹⁰ | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 |
| Ferrosilicon | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Other | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Total | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Korea, Republic of, electric furnace: | | | | | |
| Ferromanganese | 140,208 | 146,373 | 143,525 | 137,000 ^{r, c} | 140,000 |
| Silicomanganese | 116,091 | 103,522 | 101,877 | 94,000 ^{r, c} | 100,000 |
| Other | 4,639 | 4,676 | 4,452 | -- ^r | -- |
| Total | 260,938 | 254,571 | 249,854 | 231,000 ^{r, c} | 240,000 |
| Macedonia, electric furnace: ^c | | | | | |
| Ferronickel | 5,000 ⁶ | -- | 10,300 | 17,000 | 19,000 |
| Ferrosilicon | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| Total | 55,000 | 50,000 | 60,300 | 67,000 | 69,000 |
| Mexico, electric furnace: ¹⁶ | | | | | |
| Ferromanganese | 79,552 | 90,501 | 60,014 | 38,532 ^r | 55,903 ⁶ |
| Silicomanganese | 113,917 | 107,923 | 74,290 | 73,263 ^r | 81,223 ⁶ |
| Total | 193,469 | 198,424 | 134,304 | 111,795 ^r | 137,126 ⁶ |
| New Caledonia, electric furnace, ferronickel ^c | 157,592 ⁶ | 157,000 | 162,000 | 171,000 | 175,000 |
| Norway, electric furnace: ^c | | | | | |
| Ferrochromium | 159,714 ⁶ | 153,500 ⁶ | 82,600 ⁶ | 61,100 ⁶ | -- |
| Ferromanganese | 235,000 | 235,000 | 240,000 | 240,000 | 245,000 |
| Ferrosilicon | 460,000 | 460,000 | 450,000 | 390,000 ^r | 350,000 |
| Silicomanganese | 230,000 | 230,000 | 230,000 | 230,000 | 230,000 |
| Silicon metal | 100,000 | 100,000 | 100,000 | 105,000 ^r | 100,000 |
| Other ⁹ | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| Total | 1,200,000 | 1,190,000 | 1,120,000 | 1,040,000 ^r | 940,000 |
| Peru, electric furnace, ferrosilicon ^c | 600 | 600 | 600 | 600 | 600 |
| Poland: | | | | | |
| Blast furnace, ferromanganese ^c | 100 | -- | 500 | 600 ^r | 600 |
| Electric furnace: | | | | | |
| Ferrosilicon | 62,481 | 56,000 | 48,600 | 42,000 ^{r, c} | 45,000 |
| Silicomanganese | 10,000 | 19,000 | 20,000 | 7,000 ^{r, c} | 10,000 |
| Silicon metal ^c | 1,200 | 1,500 | 1,500 | 1,500 | 1,500 |
| Other ^c | 2,700 | 2,700 | -- | -- | -- |
| Total | 76,481 | 79,200 | 70,600 | 51,100 ^{r, c} | 57,100 |
| Romania, electric furnace: | | | | | |
| Ferromanganese | 25 ^e | 1,044 | 384 | -- | -- |
| Ferrosilicon | 5,000 ^e | 5,000 ^e | 5,823 | -- | -- |
| Silicomanganese | 550 ^e | 21,158 | 71,921 | 88,665 | 85,000 |
| Total | 5,575 | 27,202 | 78,128 | 88,665 | 85,000 |

See footnotes at end of table.

TABLE 6--Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE^{1,2}

(Metric tons, gross weight)

| Country, furnace type, and alloy type ^{3,4,5} | 1999 | 2000 | 2001 | 2002 | 2003 ^c |
|--|----------------------|------------------------|------------------------|------------------------|----------------------|
| Russia: ^c | | | | | |
| Blast furnace: | | | | | |
| Ferromanganese | 90,000 | 70,700 | 70,000 | 80,000 | 85,000 |
| Ferrophosphorus | 3,500 | 3,500 | 3,500 | 3,500 | 3,500 |
| Spiegeleisen | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 |
| Electric furnace: | | | | | |
| Ferrochromium | 249,000 ⁶ | 274,000 ⁶ | 210,600 ⁶ | 210,000 ⁶ | 357,000 ⁶ |
| Ferrochromiumsilicon | 4,500 | 4,500 | 4,000 | 4,000 | 4,000 |
| Feronickel | 33,000 | 35,000 | 30,000 | 30,000 | 30,000 |
| Ferrosilicon | 601,000 ⁶ | 652,000 ⁶ | 707,100 ⁶ | 701,000 | 760,000 |
| Ferrovanadium | 16,000 | 20,500 | 18,800 | 15,100 | 8,000 |
| Silicon metal | 40,000 | 40,000 | 40,000 | 40,000 | 45,000 |
| Other | 24,000 ^r | 19,500 ^r | 16,200 ^r | 14,900 ^r | 22,000 |
| Total | 1,070,000 | 1,130,000 | 1,110,000 | 1,110,000 | 1,320,000 |
| Saudi Arabia, electric furnace, other ^c | 83,000 | 83,000 | 78,000 | 75,000 | 75,000 |
| Slovakia, electric furnace: ^c | | | | | |
| Ferrochromium | 6,986 ⁶ | 17,702 ⁶ | 5,968 ⁶ | 5,695 ⁶ | 1,924 ⁶ |
| Ferromanganese | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 |
| Ferrosilicon | 50,000 | 70,000 | 50,000 | 50,000 | 50,000 |
| Silicomanganese | 35,000 | 35,000 | 35,000 | 35,000 | 35,000 |
| Other | 5,000 | 5,000 | 5,000 | 5,000 | -- |
| Total | 117,000 | 148,000 | 116,000 | 116,000 | 107,000 |
| Slovenia, electric furnace: | | | | | |
| Ferrochromium | 560 | -- | -- | -- | -- |
| Ferrosilicon ^c | 8,000 | 8,000 | 8,000 | 8,000 | 9,000 |
| Other ^{c,7} | 200 | 200 | 200 | 200 | -- |
| Total ^c | 8,760 | 8,200 | 8,200 | 8,200 | 9,000 |
| South Africa, electric furnace: | | | | | |
| Ferrochromium | 2,155,202 | 2,574,000 | 2,141,000 | 2,351,122 ^r | 2,470,000 |
| Ferromanganese | 527,000 | 596,873 | 498,000 | 619,000 ^r | 650,000 |
| Ferrosilicon | 106,000 | 108,500 ^r | 107,600 ^r | 141,700 ^r | 145,000 |
| Ferrovanadium | 6,000 ^e | 18,000 ^e | 18,184 ^r | 25,227 ^r | 28,000 |
| Silicomanganese | 267,000 | 310,000 | 253,000 | 276,000 ^r | 375,000 |
| Silicon metal | 35,800 | 40,600 | 39,400 ^r | 43,000 ^r | 45,000 |
| Other ^{c,17} | 32,000 | 30,000 | 64,000 ^r | 82,000 ^r | 87,000 |
| Total | 3,129,002 | 3,677,973 ^r | 3,121,184 ^r | 3,538,049 ^r | 3,800,000 |
| Spain, electric furnace: ^c | | | | | |
| Ferrochromium | 935 ⁶ | 905 ⁶ | -- | -- | -- |
| Ferromanganese | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Ferrosilicon | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| Silicomanganese | 95,000 | 100,000 | 100,000 | 100,000 | 100,000 |
| Silicon metal | 28,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| Other | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| Total | 179,000 | 186,000 | 185,000 | 185,000 | 185,000 |
| Sweden, electric furnace: | | | | | |
| Ferrochromium | 113,140 | 135,841 | 109,198 | 118,823 | 110,529 ⁶ |
| Ferrosilicon | 21,440 | 20,000 | 22,000 ^e | 23,000 ^e | 24,000 |
| Total | 134,580 | 155,841 | 131,198 | 141,823 | 135,000 |
| Taiwan, electric furnace, ferrosilicon | 3,212 | 2,975 | 1,181 | -- | -- |
| Turkey, electric furnace: | | | | | |
| Ferrochromium | 99,105 | 97,640 | 50,735 | 11,200 ^e | 35,393 ⁶ |
| Ferrosilicon | 420 | -- | 5,895 | 7,245 | 7,000 |
| Total | 99,525 | 97,640 | 56,630 | 18,445 | 42,400 |

See footnotes at end of table.

TABLE 6--Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE^{1,2}

(Metric tons, gross weight)

| Country, furnace type, and alloy type ^{3,4,5} | 1999 | 2000 | 2001 | 2002 | 2003 ^e |
|--|------------------------|-------------------------|-------------------------|-------------------------|----------------------|
| Ukraine: | | | | | |
| Blast furnace: ^e | | | | | |
| Ferromanganese | 57,800 | 85,400 | 85,000 | 85,000 | 85,000 |
| Spiegeleisen | 2,500 | 5,400 | 5,000 | 5,000 | 5,000 |
| Electric furnace: | | | | | |
| Ferromanganese | 199,539 | 252,679 | 231,000 ^r | 250,617 ^r | 250,000 |
| Ferronickel ^e | -- | 10,800 | 41,000 | 31,000 ^r | 52,000 |
| Ferrosilicon | 243,600 | 323,417 | 231,000 ^r | 250,617 ^r | 250,000 |
| Silicomanganese | 498,905 | 684,040 | 702,389 ^r | 732,592 ^r | 740,000 |
| Other ^e | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 |
| Total | 1,027,344 | 1,386,736 | 1,320,389 ^r | 1,379,826 ^r | 1,410,000 |
| United States, electric furnace: | | | | | |
| Ferrochromium ¹⁸ | W | W | W | W | W |
| Ferromanganese ¹⁹ | W | W | W | W | W |
| Ferrosilicon | 325,000 | 250,000 ^e | 191,000 | 182,000 | 143,000 ⁶ |
| Silicon metal | 186,000 | 175,000 ^e | 131,000 | 108,000 | 133,000 ⁶ |
| Other ²⁰ | W | W | W | W | W |
| Total | 511,000 | 425,000 ^e | 322,000 | 290,000 | 276,000 ⁶ |
| Uruguay, electric furnace, ferrosilicon ^e | 200 | 200 | 200 | 200 | 200 |
| Venezuela, electric furnace: | | | | | |
| Ferromanganese | 10,694 | 15,655 | 12,715 | 12,000 ^e | 12,000 |
| Ferronickel | -- | 133 | 32,300 | 51,700 ^e | 57,300 |
| Ferrosilicon | 38,886 | 56,926 | 46,236 | 99,576 ^r | 90,543 ⁶ |
| Silicomanganese | 47,635 | 69,735 | 56,640 | 36,974 ^r | 30,632 ⁶ |
| Total | 97,215 | 142,449 | 147,891 | 200,250 ^r | 190,475 ⁶ |
| Zimbabwe, electric furnace: | | | | | |
| Ferrochromium | 244,379 | 246,324 | 243,584 | 258,164 | 245,200 ⁶ |
| Ferrochromiumsilicon | 16,267 | 19,631 | 16,848 | -- | -- |
| Total | 260,646 | 265,955 | 260,432 | 258,164 | 245,200 ⁶ |
| Grand total: | 17,900,000 | 19,600,000 | 18,900,000 ^r | 19,900,000 ^r | 22,100,000 |
| Of which: | | | | | |
| Blast furnace: | | | | | |
| Ferromanganese | 1,000,000 | 956,000 | 956,000 | 966,000 | 901,000 |
| Spiegeleisen | 9,500 | 12,400 | 12,000 | 12,000 | 12,000 |
| Other ²¹ | 104,000 | 104,000 | 104,000 | 104,000 | 104,000 |
| Total, blast furnace | 1,110,000 | 1,070,000 | 1,070,000 | 1,080,000 | 1,020,000 |
| Electric furnace: | | | | | |
| Ferrochromium ²² | 5,000,000 | 5,750,000 ^r | 4,680,000 | 5,060,000 ^r | 5,730,000 |
| Ferrochromiumsilicon | 85,000 | 94,800 | 116,000 | 121,000 | 117,000 |
| Ferromanganese ²³ | 2,670,000 ^r | 2,860,000 | 2,860,000 ^r | 2,830,000 ^r | 3,100,000 |
| Ferronickel | 802,000 ^r | 867,000 ^r | 949,000 | 1,000,000 | 1,040,000 |
| Ferrosilicon | 3,900,000 | 4,240,000 | 4,030,000 ^r | 4,220,000 ^r | 4,900,000 |
| Silicomanganese ²³ | 2,960,000 | 3,430,000 | 3,660,000 ^r | 4,130,000 ^r | 4,540,000 |
| Silicon metal | 681,000 | 729,000 | 629,000 | 615,000 ^r | 642,000 |
| Other ²⁴ | 669,000 | 586,000 | 914,000 ^r | 842,000 ^r | 993,000 |
| Total, electric furnace | 16,800,000 | 18,600,000 ^r | 17,800,000 ^r | 18,800,000 ^r | 21,100,000 |

See footnotes at end of table.

TABLE 6--Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE^{1, 2}

⁶Estimated. ⁷Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- Zero.

¹World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through August 20, 2004.

³In addition to the countries listed, Iran is believed to have produced ferromanganese, ferromolybdenum, and silicomanganese, but production information is inadequate for the formulation of estimates of output levels.

⁴To the extent possible, ferroalloy production of each country has been separated according to the furnace from which production is obtained; production derived from metallothermic operation is included with electric furnace production.

⁵To the extent possible, ferroalloy production of each country has been separated to show the following individual major types of ferroalloys: ferrochromium, ferrochromiumsilicon, ferromanganese, ferronickel, ferrosilicon, silicomanganese, silicon metal, and spiegeleisen. Ferroalloys other than those listed that have been identified specifically in sources, as well as those ferroalloys not identified specifically, but which definitely exclude those listed previously in this footnote, have been reported as "Other." Where one or more of the individual ferroalloys listed separately in this footnote have been inseparable from other ferroalloys owing to a nation's reporting system, deviations are indicated by individual footnotes.

⁶Reported figure.

⁷Includes calcium-silicon.

⁸Includes high- and low-carbon ferrochromium.

⁹Includes, if any, silicospiegeleisen.

¹⁰Includes, if any, ferrochromiumsilicon, ferronickel, and silicomanganese.

¹¹Hungary is believed to produce some blast furnace ferromanganese.

¹²Includes charge chrome and ferrochrome.

¹³Excludes calcium-silicon.

¹⁴Includes high- and low-carbon ferrochromium and ferrochromiumsilicon.

¹⁵Includes calcium-silicon, ferrocolumbium, ferromolybdenum, ferrotungsten, ferrovanadium, and other ferroalloys.

¹⁶Salable products from Autlán.

¹⁷Includes, if any, ferronickel.

¹⁸U.S. output of ferrochromium includes chromium metal, high- and low-carbon ferrochromium, ferrochromium silicon, and other chromium materials.

¹⁹U.S. output of ferromanganese includes manganese metal and silicomanganese.

²⁰May include ferroboration, ferrocolumbium, ferromolybdenum, ferrophosphorus, ferrotitanium, ferrotungsten, ferrovanadium, nickel columbium, and silvery pig iron.

²¹Includes ferrophosphorus and data contained in "Blast furnace, other."

²²Ferrochromium includes ferrochromium silicon, if any, for Japan, South Africa, and the United States.

²³U.S. production is included in "Other."

²⁴Includes calcium-silicon, ferromolybdenum, ferrovanadium, and silicomanganese for the United States.